REMARKS

Claims 1-31 are pending in the present application. Claims 1-3, 6, and 7 have been provisionally elected. Claims 23-31 are new.

Claims 1, 16, 17, 20, and 25 are independent. Applicants submit that claim 1 is generic and requests consideration of at least all of its dependent claims if claim 1 is found allowable.

Claim Rejection – 35 U.S.C. 112, first paragraph, enablement

Claims 1-3, 6, and 7 have been rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. In particular, the Office Action alleges that the added language "to perform white display, in a surface of the first substrate incoming light to the liquid crystal layer becomes linearly polarized light in arbitrary directions in a visible wavelength range" was not described in the specification in such a way as to enable one skilled in the art to make or use the invention. The Office Action further states that the specification does not disclose which property of the liquid crystal layer causes this to occur or how to develop a liquid crystal composition that causes incident light to be linearly polarized in arbitrary directions.

Applicants submit that the specification does enable one of ordinary skill in the art to make and use the present invention. In particular, Applicants submit that it is not one specific property that causes the linearly polarized light to be transmitted in different directions. The present application discloses

various combinations of properties that enable one to make a liquid crystal display device that produces a sufficient black display as well as a sufficient white display, over the whole wavelength range of visible light. The present invention produces this superior display quality by the combination of a circularly polarizing unit that can circularly polarize light over the whole wavelength range of visible light, a liquid crystal layer that based on the amount of applied voltage can polarize the light from circularly polarized light into linearly polarized light. As is disclosed in the present specification (at page 10, first full paragraph), in order to provide a bright state, light should be linearly polarized on the reflector plate. In order to provide a dark state, light should be circularly polarized on the reflector plate. The present invention achieves that objective.

Applicants submit that the properties of the liquid crystal layer of the present invention are sufficiently disclosed. Properties of the liquid crystal layer, including twist angle, Δnd, alignment of the crystal molecules, etc., are disclosed in various ranges, providing a display device that can produce a superior quality display in both the bright state and the dark state.

With respect to the claim language "arbitrary directions," the Office action appears to interpret this phrase as if a property of the liquid crystal layer causes light to be polarized in arbitrary directions. Applicants intended the claim to mean that the liquid crystal layer of the present invention is such that it can produce linearly polarized light out of circularly polarized light over

the whole frequency range of visible light, and will produce a white display irrespective of the direction of the linearly polarized light; hence the term "arbitrary." In other words, the term "arbitrary directions in a visible wavelength range" was intended to be a range of directions that the liquid crystal layer will operate in producing white display.

In the liquid crystal layer of the present invention, the direction of the linearly polarized light is dictated by the particular wavelength of the light. Linearly polarized light of different wavelengths will be transmitted at different respective directions; i.e., a plurality of wavelengths will be transmitted at a corresponding plurality of directions. The liquid crystal layer receives light at a plurality of wavelengths because the circular polarizing unit passes light over a plurality of wavelengths.

The language of the claim was based on statements made in the specification at page 43. However, due to the apparent misinterpretation of the claim as though it recites that the liquid crystal layer has a property that it causes light to be polarized in arbitrary directions, Applicants have again amended the claim to explicitly recite the relationship between the direction of polarization and the wavelength of light.

The direction of polarization is dictated by the wavelength of light, and this characteristic is due to physical properties of the liquid crystal layer of the present invention. Properties of the present liquid crystal layer that produce sufficient bright display and dark display are disclosed throughout the

specification and drawings. Thus, Applicants submit that the present invention has been disclosed such that one of ordinary skill in the art can make and use the present invention. Accordingly, Applicants respectfully request that the rejection be withdrawn.

Claim Rejection – 35 U.S.C. 112, second paragraph

Claims 1-3, 6, and 7 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite. In particular, the Office Action states that it is unclear if the claim recites that light is linearly polarized in random directions of if light is linearly polarized in various directions depending on wavelength.

The Office Action has apparently misinterpreted the claim as though it recites that the liquid crystal layer causes the light to be linearly polarized in arbitrary directions. As noted above, the limitation of "linearly polarized light in arbitrary directions in a visible wavelength range" was intended to be a range that the liquid crystal layer will operated to perform a white display. In any case, Applicants have amended the claim to explicitly recite the later interpretation expressed in the Office Action, i.e., the relationship between direction of polarization and wavelength of light that is caused by properties of the liquid crystal layer. As mentioned above properties of the liquid crystal layer of the present invention are disclosed throughout the present specification and drawings. Thus, Applicants submit that the claim

amendment answers the concerns expressed in the Office Action. Accordingly, Applicants respectfully request that the rejection be withdrawn.

New Claims

An objective of the present invention is to produce both a sufficient black display and a sufficient white display in a liquid crystal display device over a whole wavelength range of the visible spectrum. Other objectives include improved manufacturing, i.e., wider tolerances, and reduced power requirements, i.e., lower voltage levels for the display state requiring voltage. In order to meet those objectives, Applicants disclose in the present application a liquid crystal display device having a combination of properties such that it can meet the requirements for a display of sufficient quality and manufacturability. In particular, the present invention circularly polarizes light for purposes of producing a dark state and linearly polarizes light for wavelengths over the whole visible spectrum for purposes of producing a bright state based on disclosed properties for the liquid crystal layer, in combination with a circular polarizing unit and a reflective layer. A minimal set of properties of the liquid crystal display are summarized in Figure 7, for example. Alternative forms of the circular polarizing unit and reflective layer are disclosed. One form of the circular polarizing unit, for example, can produce elliptical polarized light (see paragraph bridging pages 46 and 47). Thus, new claims have been added to

cover the scope of the disclosed invention that meets the objectives. Applicants submit that no new matter has been added.

The present invention includes a liquid crystal layer that polarizes incoming substantially circularly polarized light into linearly polarized light at wavelengths over the whole visible spectrum; i.e., the circular polarizing unit passes light at wavelengths over the whole visible spectrum. When voltage is applied, the circular polarization unit and liquid crystal layer are such that the circularly polarized light produces a superior dark display. Further, the circular polarizer unit produces a white display irrespective of the direction of reflected linearly polarized light coming out of the liquid crystal layer.

Sonehara (a prior art reference previously applied against the present invention) discloses a liquid crystal display device in which circularly polarized light is converted to linearly polarized light which is perpendicular to a quarter wavelength plate (Sonehara at column 7, lines 15-19). The reflected linearly polarized light either passes through the linear polarizing plate, producing a clear display (column 7, lines 6-8), or is blocked by the polarizing plate, producing a black display (column 7, lines 17-19). The circular polarizing plate produces a circularly polarized light at a single wavelength (550 nm) in order for conversion to linearly polarized light perpendicular to the quarter wave plate.

Thus, unlike Sonehara, the present claimed invention is directed to a liquid crystal display device having a circular polarizing unit such that

incoming substantially circularly polarized light at the liquid crystal layer is polarized in a plurality of directions respectively representative of a plurality of wavelengths of natural light. An advantage of the present invention is that manufacturing tolerances such as precision in the thickness of the liquid crystal layer can be widened, while producing a high quality bright state display. Because all presently added claims recite this limitation, Applicants submit that the new claims distinguish over Sonehara.

CONCLUSION

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert Downs (Reg. No. 48,222) at the telephone number of (703) 205-8000, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit

Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully Submitted,

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